

Appl. No. 10/680,150
Amdt. dated April 13, 2005
Reply to Office action of January 13, 2005

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

5 Claim 1 (Currently Amended): A method of phase splitting for generating multi-phase clocks having the same frequency and predetermined phase differences between one another, comprising:
a plurality of reference clocks each generating an output of a first frequency having a first phase difference from other reference clocks; and
10 utilizing a plurality of periods in the output of each reference clock to generate a plurality of output clocks each having a second frequency at a second phase difference from other output clocks, each period of the second frequency being equal to the plurality of periods utilized in the output of one of the reference clocks.
15 ~~generating multi-phase reference clocks having the same frequency higher than an output clock frequency and a multiple of the output clock frequency, the reference clocks having a predetermined reference phase difference between one another; and~~
20 ~~generating output clocks wherein periods of each output clocks are triggered by the corresponding reference periods apart from other reference periods by at least one or a plurality of periods of the reference clock.~~

Claim 2 (Currently Amended): The method of claim 1 wherein the first frequency of the reference clocks is a multiple of the second frequency output clocks.

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Claim 3 (Currently Amended): The method of claim 1 wherein the reference first phase difference is ~~plural times as high as an output~~ a multiple of the second phase difference, wherein ~~the~~ a ratio of the reference first phase difference to the second

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phase difference is the same as a ratio of the plurality of reference clocks to the plurality of output clocks the reference clocks and the output clocks.

Claim 4 (Currently Amended): The method of claim 1 wherein when the first frequency

5 of the reference clocks is N times the second frequency as high as the output clocks, the method further comprises triggering periods of the corresponding output clocks second frequency according to the plurality of periods utilized in the output of one of the reference clocks the plurality of reference periods at intervals of at least (N-1) period.

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Claim 5 (Currently Amended): The method of claim 1 wherein if two reference clocks have the reference first phase difference of 360 degrees, the two reference clocks are essentially the same, and when using the two reference clocks to generate the corresponding two corresponding output clocks, the two corresponding output 15 clocks are triggered by different reference periods of one reference clock.

Claim 6 (Currently Amended): The method of claim 1 wherein the two of the plurality of reference clocks are a first reference clock and a second reference clock, the method further comprising:

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determining a first reference period of the first reference clock and also finding a second first reference period in the second reference clock [],[] lagging the first reference period of the first reference clock;

dividing the frequency of the first reference clock at a time point corresponding to the first reference period of the first reference clock in order to generate an 25 output clock; and

dividing the frequency of the second reference clock at a time point corresponding to the second first reference period of the second reference clock in order to generate another output clock.

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Claim 7 (Currently Amended): The method of claim 6 wherein the first reference clock leads the second reference clock by the ~~reference~~ first phase difference.

5 Claim 8 (Currently Amended): The method of claim 1 wherein the periods of each output clock are triggered by ~~the~~ a reference periods of ~~the~~ a corresponding reference clock apart from other reference clocks by at least one or a plurality of periods of the corresponding reference clock wherein if a first period of ~~an~~ one of the output ~~clock~~ clocks is triggered by ~~the~~ a first reference period of a corresponding reference clock,
10 a second period of said one of the output ~~clock~~ clocks would be triggered by ~~the~~ a reference period lagging the first reference period by the predetermined first phase difference in ~~the~~ a second reference clock, the second period of said one of the output ~~clocks~~ lagged lagging the first period of said one of the output ~~clocks~~ by the determined second phase difference.

15 Claim 9 (Currently Amended): The method of claim 1 wherein the two reference clocks are a first reference clock and a second reference clock, the method further comprising:

selecting a first reference period in the first reference clock;
20 in the second reference clock, stopping ~~the~~ a reference period ~~from~~ lagging the first reference period to generate ~~an~~ a corresponding intermediate clock so that each reference period of the corresponding intermediate clock will lag the first reference period in the first reference clock; and
dividing the frequency of the first reference clock and the corresponding
25 intermediate clock to generate two corresponding output clocks.

Claim 10 (Currently Amended): A multi-phase clock-generating circuit for generating two output clocks of the same frequency with a predetermined phase difference between

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each other, comprising:

a clock generator for generating two reference clocks having ~~the a~~ same frequency
~~higher than and that is a multiple greater than 1~~ of the frequency of a
corresponding the two output clock clocks, the two reference clocks having a
predetermined reference phase difference between each other; and

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a phase interpolator for generating the two corresponding output clocks wherein
each period of these two output clocks is triggered by ~~the a~~ corresponding
reference period of one of the two reference clocks, which is apart from other
reference periods of said one of the two reference clocks by at least one or a
plurality of periods of said one of the two reference clocks~~the reference clock~~.

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Claim 11 (Currently Amended): The multi-phase clock-generating circuit of claim 10
wherein the two reference clocks are a first reference clock and a second reference
clock, the multi-phase clock-generating circuit further comprising:

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a sequence triggering module for stopping ~~the a~~ reference period of the second
reference clock ~~from~~ lagging ~~the a~~ first reference period of the first reference
clock to generate an a corresponding intermediate clock; and

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a frequency division module for dividing the frequency of the first reference clock
and the corresponding intermediate clock to generate two corresponding
output clocks; wherein each reference period of the corresponding
intermediate clock lags the first reference period ~~in~~ of the first reference clock.

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Claim 12 (Currently Amended): The multi-phase clock-generating circuit of claim 11
wherein the first reference clock leads the second reference clock by the
predetermined reference phase difference.

Claim 13 (Currently Amended): The multi-phase clock-generating circuit of claim 10
wherein ~~the~~ two reference clocks are a first reference clock and a second reference

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clock, and the phase interpolator comprises:

a sequence triggering module for finding in the second reference clock a ~~second~~ first reference period lagging the ~~a~~ first reference period of the first reference clock, and producing a corresponding reset signal at the ~~a~~ a time corresponding to the ~~second~~ first reference period of the second reference clock ~~reference period~~;

5 a first frequency divider for generating an output clock by dividing the frequency of the first reference clock; and

a second frequency divider for generating the other output clock by dividing the frequency of the second reference clock after receiving the corresponding reset

10 signal.

Claim 14 (Currently Amended): The multi-phase clock-generating circuit of claim 13 wherein the first frequency divider and the second frequency divider are triggered by rising edges of the first and second reference clocks respectively.

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Claim 15 (Original): The multi-phase clock-generating circuit of claim 10 wherein the frequency of the reference clocks is a multiple of the frequency of the output clocks.

Claim 16 (Currently Amended): The multi-phase clock-generating circuit of claim 10
20 wherein the predetermined reference phase difference is plural times ~~as high as the~~
~~an~~ output phase difference between outputs of the output clocks, and ~~the~~ a ratio of the predetermined reference phase difference to the output phase difference is the same as ~~the~~ a ratio of the frequency of the two reference clocks ~~and to~~ the frequency of the output clocks.

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Claim 17 (Currently Amended): A method of phase-splitting for generating two output clocks of the same frequency with a predetermined phase difference between each other, comprising:

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generating a first reference clock having a frequency higher than and a that is a multiple greater than 1 of a frequency of a corresponding output clock, and substantially equal to an integer multiple of a reference period of the first reference clock; and

5 triggering periods of the different said two output clocks by the reference periods period of the corresponding reference clocks clock to generate the two output clocks.

Claim 18 (Currently Amended): The method of claim 17 wherein the predetermined
10 phase difference of the two output clocks is not essentially equal to 360 degrees.

Claim 19 (Currently Amended): The method of claim 17 wherein the predetermined
phase difference of the two output clocks is not essentially equal to 180 degrees.

15 Claim 20 (Currently Amended): The method of claim 17 wherein if the frequency of the reference clock is N times as high as that of the corresponding output clock, the predetermined phase difference of the two output clocks is a multiple of 360/N degrees.

20 Claim 21 (Currently Amended): The method of claim 17 wherein the frequency division is triggered by the first-reference period of the first reference clock to generate an output clock, the a second reference period lagging the first reference period of the first reference clock starting frequency division to generate another output clock.

25 Claim 22 (Currently Amended): The method of claim 17 wherein a third output clock can be produced, the third output clock having the same frequency as the two output clocks but different phase, the method further comprising:
generating a second reference clock having the same clock frequency but a different

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reference phase as the first reference clock; and
triggering each period of the third output clock according to each period of the
second reference clock;
wherein output of the third output clock is of the same frequency as said two output
5 clocks and has the predetermined phase difference from said two output
clocks.